Reptiles as Long-lived Receptors for Ecological Risk Assessment in Aquatic Ecosystems of the Southeastern U.S.

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Introduction

Future management and remediation recommendations for contaminated aquatic ecosystems will depend in part on predicted risks to wildlife species from contaminant exposure and accumulation. The Savannah River Site (SRS), near Aiken, South Carolina, USA, is a 800-km² Department of Energy installation at which some localized areas contain elevated concentrations of radioactive and metal contaminants. Ecological risk assessment models have been developed for river otters and belted kingfishers to examine the potential effects of metal contaminants on wildlife associated with aquatic systems on the SRS; however, models for these relatively short-lived species (otters, 8-9 yrs; kingfisher, 15 yrs) may not adequately estimate the exposure risks for species at similar trophic levels but with much longer life spans. American alligators and several turtles species occur in aquatic systems of the SRS, have diets composed largely of vertebrates and/or invertebrates, and have estimated longevities of up to 70 yrs. By virtue of their long life spans, physiology, and trophic status as top predators, alligators and turtles may accumulate significant body burdens of a variety of contaminants. Thus these species may be good ecological receptors for assessing risks associated with long-term contaminant exposure.

Methods

Sampling began in April 2010 and we sampled turtles—primarily yellow-bellied sliders (Trachemys scripta)—and alligators (Alligator mississippiensis) from a series of aquatic sampling sites that differed in their contaminant types, levels and spatial scales, including references sites not known to be contaminated. We permanently and uniquely marked all animals, took standard morphometric measurements, and measured gamma radiation. In addition, we collected whole blood, nail, and scute (alligators only) samples for metals analysis.

Results

D-Area Ash Basins
- Coal-fired steam production facility that generates coal fly ash waste
- Fly ash deposition basins (~500 m²) from Savannah River
- Contains trace elements including arsenic, chromium, cadmium, and selenium
- Metals found at high levels in aquatic and semi-aquatic biota
- Some above EPA limits for humans
- Contaminated taxa include reptiles, amphibians, mammals, fish, invertebrates, and birds based on previous sampling

AO1 Wetland Complex
- A complex of retention ponds with eight artificial wetlands designed to remove metals (primarily copper and lead) from industrial effluent
- The Upper Pond (0.62-ha retention basin) receives facilities' effluent
- The Lower Pond (0.52-ha impoundment) receives remediated wetland effluent

Discussion

- Monitoring accumulation of 137Cs and trace metals in wildlife is important in determining potential risks of long-term contaminant exposure
- Additionally, results may lead to more stringent requirements and regulations pertaining to the human consumption of alligators and turtles
- The Environmental Protection Agency (EPA) sets contaminant level goals (MCLGs) for human consumption at 0.5 ppm (Hg), 20 ppm (Cd), and 0.5 ppm (Se)
- Our data, when combined with long-term mark-recapture and previously collected body burden data, offer the opportunity to study legacy effects of contaminants in aquatic systems
- Although some metal and radionuclide analyses documented elevated levels, most captured animals appear to be physically healthy
- Future work will include measuring other biological endpoints, including reproductive success, hatchling fitness, and molecular and cellular level damage

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